MULTIMEDIA UNIVERSITY

STUDENT ID NO

TABLE NO. _____

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

TIC2151 THEORY OF COMPUTATION

(All sections / Groups)

Question	Marks
1	
2	
3	
4	
Total 50 Marks (50%)	

4th July 2023
9.00 am – 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 7 pages only excluding the cover page.
2. Attempt All questions. The distribution of the marks for each question is given.
3. Please print all your answers clearly and neatly in the specified ANSWER BOX provided for each question. Submit this question paper at the end of the examination.

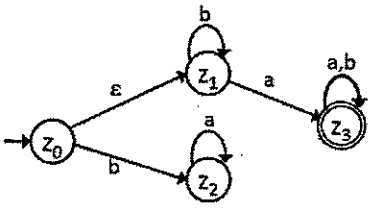
QUESTION (1)

(A) Draw state diagrams for DFAs accepting each of the following languages:

$L_1 = (0+1)1(0+1)^+$ [3 marks]

$L_2 = \{w \in \{a, b\}^* \mid w$ has neither *aa* nor *bb* as a substring$\}$. [3 marks]

(B) Convert the following NFA into an NFA without ε-transition. Show your steps. [4 marks]



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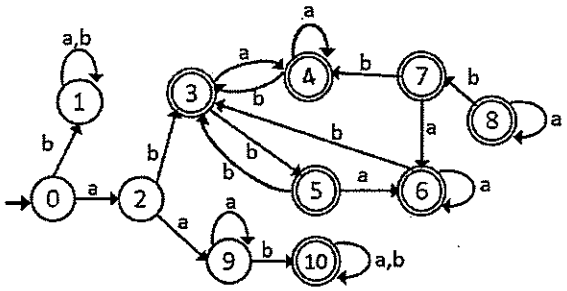
(C) Minimize the following DFA. Show your steps. [5 marks]



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QUESTION (2)

(A)

1. Determine the language corresponding to each of the following regular expressions:
   i. $(0 + 1)^+ 101 + (0 + 1)^+ 010$ [1.5 Marks]
   ii. $(1 + 0)^* 00 (1 + 0)^* 00 (1 + 0)^*$ [1.5 Marks]

2. Find a regular expression corresponding to each of the following languages.
   i. $L = \{w \in \{a, b\}^* \mid w = a^{2n} b^{3m} ab , n \geq 0, m \geq 1 \}$ [1.5 Marks]
   ii. $L=\{ w \in \{a, b, c\}^* \mid$ w contains bcc as a substring.$\}$ [1.5 Marks]

(B) Convert the following regular expression into an NFA. Follow the construction rules closely and do not just give a simpler NFA even though it is possible. [4 marks]

$(01)^*0(0 + 1)$

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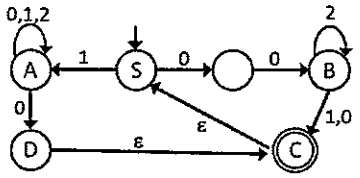
(C)

1. What is the regular grammar corresponding to the NFA given below? [2 Marks]



2. Give the regular grammars corresponding to each of the following languages over the alphabet {a, b}.

$L_1 = 01^* 01^+$ [1.5 Marks]

$L_2 = 0\ (10)^+\ 111\ (01)^*\ 0$ [1.5 Marks]

L_1:	L_2:

Continued...

QUESTION (3)

(A) Construct a PDA over the alphabet {a, b, c} for of the following language:

$L = \{ wcw^R \mid w \in \{a, b\}^+ \}$. [4 Marks]

(B) Give the context free grammars corresponding to each of the following languages over the alphabet:

$L_1 = \{w \in \{0, 1)^* \mid |w| \text{ is odd and starts with } 0 \}$ [1.5 Marks]

$L_2 = \{w \in \{a, b\}^* \mid w = b\, a^{2n} b^{2n} , n \geq 2 \}$ [1.5 Marks]

L_1:	L_2:

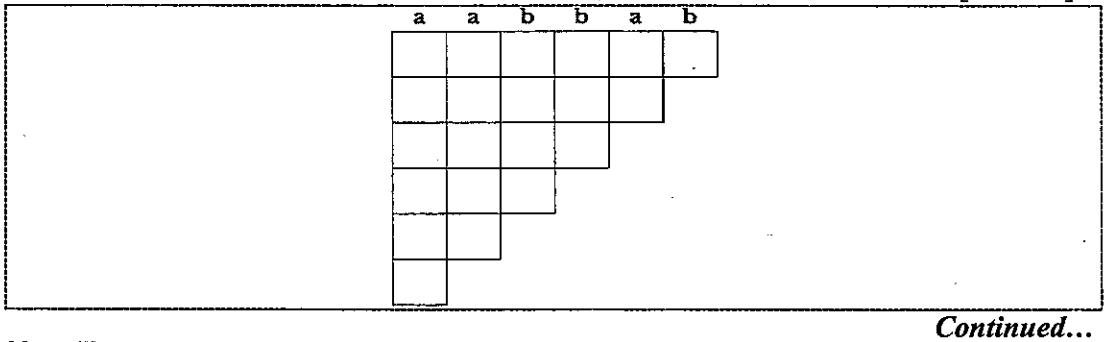
(C) Can the word "***aabbab***" be derived from the given CNF grammar using the Cocke-Younger-Kasami (CYK) algorithm? (Answer: YES / NO). Prove your answer.

$S \rightarrow SS \mid XA \mid XY$

$A \rightarrow SY$

$X \rightarrow a$

$Y \rightarrow b$ [3 marks]



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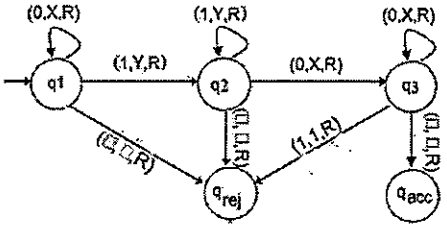
QUESTION (4)

(A) What language does the following Turing machine accept? Give the language in regular expression form. [2 marks]



(B) Construct a Turing Machine for the language $L = \{a^n b^n c^m | m,n \geq 1\}$. [5 marks]

(C) Briefly define *Turing-decidable* and *Turing-recognizable* languages. [3 marks]

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